SUDOKU: NEAR-SURFACE DISPOSAL OPTIMIZATION BASED ON KNOWLEDGE AND UNDERSTANDING

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The EURAD-2 WP SUDOKU aims to deepening the current understanding of the behaviour and performances of multilayer covers and cementitious barriers in near-surface disposal facilities. A consortium of experts from 29 European institutions will jointly perform laboratory experiments and *in situ* tests, combined with modelling studies to achieve this objective. The SUDOKU approach combines the investigations on multilayer covers with the durability studies of cementitious barriers to assess the transport properties of mobile radionuclides (such as C-14, Cl-36, I-129, Tc-99) in damaged cementitious barriers according to their chemo-mechanical evolution.

The work programme in SUDOKU is organized in three technical tasks: (i) performance of multilayer covers (Task 3), (ii) chemo-mechanical evolution of reinforced and unreinforced cementitious barriers and the effect on the migration of mobile radionuclides (Task 4), and (iii) modelling the evolution of the engineered barrier system (EBS) and its consequence for radionuclide migration based of the experimental results obtained in SUDOKU (Task 5). These tasks are complemented by a task dedicated to knowledge management (Task 2) aiming to capture knowledge relevant for SUDOKU and to contribute to knowledge transfer to the EURAD-2 community and beyond through the EURAD-2 KM programme.

One goal of SUDOKU is to improve the current state of knowledge of the processes that control water infiltration in multilayer covers and to evaluate the cover effectiveness and its long-term performance. To achieve this, in-situ monitoring on existing and under construction multilayer cover mock-ups, complemented by laboratory scale experiments, will be performed to study separately and under controlled conditions the behaviour of different soil layers and combinations of layers that form the cover.
Furthermore, the coupling of mechanical constraints and chemical alterations on unreinforced cement-based materials and similar systems with steel reinforcement, as well as the coupled effect on mobile radionuclides migration will be investigated. This will allow assessing the consequences of the cementitious EBS chemo-mechanical degradation on the long-lived radionuclides migration under relevant conditions for shallow and near-surface disposal facilities.

The experimental results achieved in the framework of SUDOKU Task 3&4 will be considered in the modelling performed in Task 5 to assess the mechanical and chemical consequences of steel reinforcement corrosion and EBS materials degradation on the transport of safety relevant radionuclides.
The combination of on-site and laboratory studies with state-of-the-art numerical models will ensure the necessary reliability of the results and facilitate the elaboration of recommendations for optimal EBS design from the safety point of view.

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